Geophysical Research Abstracts
Vol. 15, EGU2013-5741, 2013
EGU General Assembly 2013

Crater Retention Ages from (4) Vesta Matching Independent Ar-Ar Ages of HED Meteorites

Nico Schmedemann (1), Thomas Kneissl (1), Boris A. Ivanov (7), Gregory G. Michael (1), Gerhard Neukum (1), Andreas Nathues (2), Holger Sierks (2), Roland Wagner (3), Katrin Krohn (3), Lucille Le Corre (2), Vishnu Reddy (2), Ottaviano Ruesch (4), Harald Hiesinger (4), Ralf Jaumann (1,3), Carol A. Raymond (5), and Christopher T. Russell (6)

(1) Freie Universität Berlin, Institute of Geological Sciences, Department of Earth Sciences, Berlin, Germany (nico.schmedemann@fu-berlin.de), (2) Max-Planck-Institut für Sonnensystemforschung, Katlenburg-Lindau, Germany, (3) German Aerospace Center, Institute of Planetary Research, Berlin, Germany, (4) Institut für Planetologie, Westfälische Wilhelms-Universität, Münster, Germany, (5) JPL, Caltech, Pasadena, CA,USA, (6) University of California, Los Angeles, CA,USA, (7) Institute of Dynamics of Geospheres, Moscow, Russia

In July 2012 the Dawn spacecraft completed its mapping task of the Main Belt asteroid Vesta with a second high altitude mapping orbit. Dawn is now on its way to the dwarf planet (1) Ceres, where it will perform a similar mapping campaign like that at Vesta [1]. The Main Belt is the source region of most impactors in the inner solar system [2,3,4], making it a key region for understanding the early history of our Solar System.
In order to determine absolute surface ages from Vesta we derived a crater production function and a chronology function for Vesta. We derived these functions from the respective lunar functions [2] and scaled [5] them to the impact conditions on Vesta [6].
In general we find good agreement between the derived crater production function and the measured crater distribution. However, we also find disagreement between 8 and 15 km crater size, on areas older ∼2.2 Ga. Older areas show a steep (∼-6 cumulative) slope, which we link to a decaying influence of the vestan collisional family (Vestoids). The lower boundary of 8 km crater size may be explained by fast ejected small spalls and/or a more efficient Yarkovsky effect [7]. This influence is not observed for instance inside the large Rheasilvia basin, which we date with ∼2.2 Ga. Since the formation of this basin is believed to be a major source of replenishment of the Vestoids, it's currently observed cratering record is not indicative for the basin formation age in contrast to [8]. The young interior of the Rheasilvia basin is likely a result of repeated resets of the crater retention age due to mass wasting processes on the basin walls. We use topographic heights, which are less affected by mass wasting such as the top of the central peak of the basin as well as proximal ejecta blankets outside the basin to date the formation age of Rheasilvia. For the central peak we derive a surface age of 3.59 (+0.079/-0.18) Ga. The proximal ejecta blanket at the Oppia crater is dated with 3.62 (+0.054/-0.087) Ga and 3.63 (+0.058/-0.096) Ga. We also find seismic (miniscule ejecta blanket from Rheasilvia) resurfacing events in the time frame of ∼3.56 to ∼3.59 Ga at several areas in the northern hemisphere, indicative for a major seismic activity probably connected to the Rheasilvia formation. An antipodal activity is also suggested by hydrocode modeling [9]. By summation of age probability curves of measurements we link to the Rheasilvia formation, we find 3.58 (+0.07/-0.12) Ga. Using a similar attempt we find 3.75 (+0.05/-0.21) Ga for the Veneneia formation. Both crater retention ages correspond within the error bars with prominent peaks of independent Ar-Ar ages of Vesta related HED meteorites [10].
Acknowledgement: This work has been supported by the German Space Agency (DLR) on behalf of the Federal Ministry of Economics and Technology, grants 50OW1101(NS,TK), 50QM1001 (GM) and 50OW1102 (OR,HH).

References: [1] Russell et al. (2007): Advances in Space Research 40(2): pp193-201, 2007. [2] Neukum and Ivanov: In: Gehrels T (ed) "Hazards due to comets and asteroids". University of Arizona Press, Tucson, 359–416, 1994. [3] O'Brien and Greenberg (2005): Icarus 178(1): 179-212. [4] Nesvorny et al. (2009): Icarus 200(2): 698-701. [5] Ivanov (2001): Chronology and Evolution of Mars 96, 87–104, 2001. [6] Schmedemann et al. (2012): 43.LPSC, The Woodlands, #1659. [7] Morbidelli et al. (2003): Icarus 162, 328-336. [8] Marchi et al. (2012): Science 336, 690. [9] Bowling et al. (2012): 75th Annual Meeting of the Meteoritical Society, 2012, Cairns, Australia. Meteoritics and Planetary Science Supplement, id.5256. [10] Bogard, D. D. (2011): Chemie der Erde - Geochemistry, vol. 71, issue 3: 207-226.